HARECES measurement of magnetic linear dichroism

Scientific Achievement

A prototype method for measuring magnetic linear dichroism in an electron microscope has been developed. This methodology complements the similar techniques that are performed on synchrotron sources and thus opens up a new avenue to explore magnetic properties at higher spatial resolution.

Significance

With the development of spin-based electronics and nanoscale manipulation of structure, tremendous efforts have been focused on fabrication and characterization of nanoscale devices. Since the spin transport occurs through the bulk of multi-layered nanostructures, techniques which are directly sensitive to the magnetic anisotropy in a specimen and at its internal interfaces are of great interest, particularly those which operate at high spatial resolution. The implementation of a method to perform this type of measurement in an electron microscope is noteworthy due to the fact that the spatial resolution of an electron microscope far exceeds all current as well as planned instrumentation at synchrotron sources. Optimizing the experimental conditions for measuring MLD will be the focus of near term research in order that we can use the method to probe the structure of interfaces between magnetic domains at the highest possible resolution.

Performers

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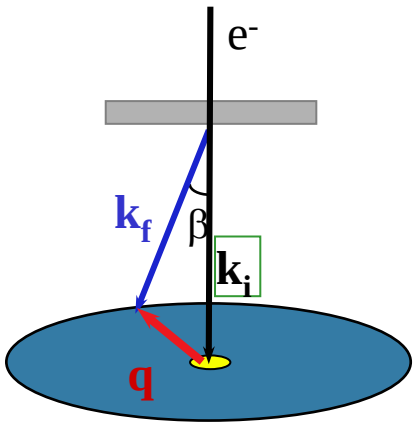
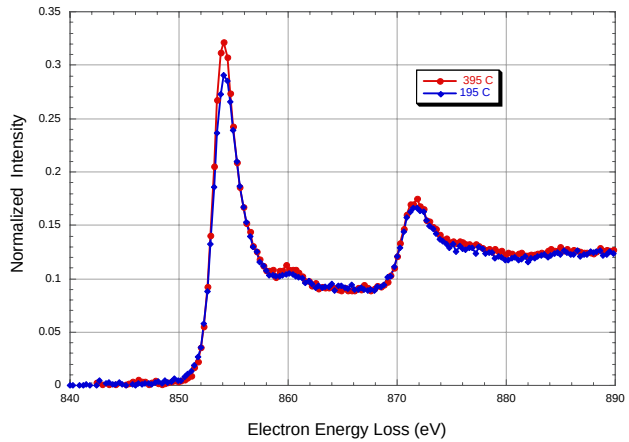
HARECES measurements of magnetic linear dichroism



Traditional EELS scattering experiments are conducted using large apertures and poor angular resolution (~ 10 mR- **aqua**). In HARECES we employ computationally mediated control of the electron microscope which permits spectroscopic measurements at angular resolutions as small as 0.05 mR (**yellow**), allowing momentum-resolved spectra to be recorded which is sensitive to the anisotropic orientation dependence of the magnetic spin in layered materials.

- A method for measurement of magnetic linear dichroism (MLD) using High Angular Resolution Electron Channeling Electron Spectroscopy in an Analytical Electron Microscope is being developed.
- This technique can facilitate the determination of magnetic anisotropy at interfaces at spatial resolutions that are defined by the diameter of the incident electron probe.
- Initial studies show the methodology is viable and near term studies will focus on establishing optimum conditions for measurements so that this can be applied at the highest spatial resolution allowing us to probe the changes at magnetic domain interfaces.



Nickel L-shell spectra recorded above (**red**) and below (**blue**) the Curie temperature to verify HARECES-based MLD is sensitive to magnetic state.

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